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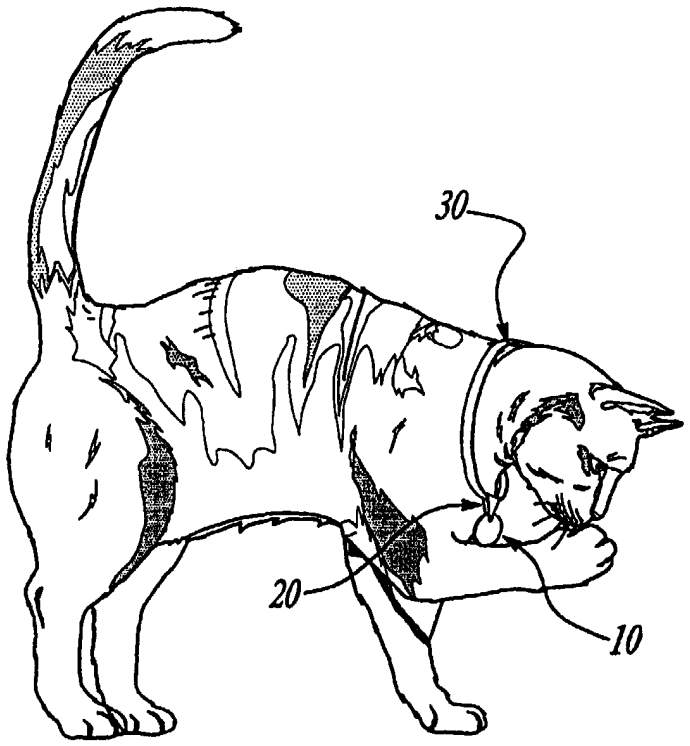
(57) Abstract

A free-swinging, slow-release insecticidal tag (10) designed for attachment to the neck collar (30) of a domesticated animal for the prevention and treatment of tick and flea infestation is described. The insecticide includes at least one pyrethroid compound, such as, but not limited to zeta-cypermerthrin. A synergist, such as, but not limited to piperonyl butoxide is combined with the zeta-cypermethrin to produce a synergized insecticide. The synergized insecticide is then impregnated into a resin base, such as, but not limited to polyvinyl chloride and then formed into an odorless sustained-release device in the shape of a tag or medallion. The tag (10) is then attached to the neck collar (30) of the animal in such a manner so as to allow the tag to physically contact various parts of the animal's body, for example, during the grooming process. The synergized insectide is released from the tag (10) over the coarse of several months and is particularly effective against all of the parasitic life stages of various domestic animal pests, such as, but not limited to ticks and fleas.



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PET MEDALLION

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority to U.S. Provisional Patent Application Serial No. 60/115,222 filed January 8, 1999.

BACKGROUND OF THE INVENTION

1. Technical Field

The present invention relates generally to insecticide compositions and, more particularly, to compositions, methods and devices containing or employing a mixture of zeta-cypermethrin and piperonyl butoxide which together provide a synergistic effect as an insecticide. The present invention is particularly useful as an insecticide either applied topically or in a sustained release delivery system, such as a resin base, for tick and flea infestation control and prevention.

2. Discussion

Insects are the most numerous of living organisms and nearly one million described species constitute approximately 70% of all animal species. Of these, about 1% are considered significant pests. These pests attack humans and/or their domestic animals; transmit human, animal, and plant diseases; destroy structures; and compete for available supplies of food and other natural resources. In the United States, at least 600 species of insects are important pests.

In an effort to control the damage done by various pests, there has been widespread use and development of pesticides. Pesticides are generally defined as any substance or chemical designed or formulated to kill or control weeds or animal pests, and include algicides, herbicides, insecticides, acaricides, and rodenticides. Insecticides are generally defined as any substance or chemical formulated to either kill or control insects. Acaricides are generally defined as any substance

or chemical formulated to either kill or control mites or ticks. Generally, control is achieved by oral ingestion of stomach poisons, contact poisons that penetrate through the cuticle, or fumigants that penetrate through the respiratory system. Ancillary chemicals are also employed in insect control and include attractants and repellants, which influence insect behavior, and chemosterilants, which influence reproduction.

The widespread use of chemical insecticides has resulted in increasing difficulties in practical pest control. The difficulties include genetic selection under chemical pressure of strains of more than 400 arthropod (insect and acarine pests) that are resistant to one or more classes of pesticides and some to every available material; resurgences of pests and outbreaks of secondary pests that result from elimination of natural enemies by the use of broad-spectrum pesticides; adverse human-health effects from injudicious use of highly toxic insecticides; and exponentially increasing costs of developing new insecticides.

With respect to the protection of domestic animals such as livestock, significant advances have been made against heretofore insecticide-resistant insect species. For example, hornflies (*Haematobia irritans*) have been effectively controlled by the use of ear tags containing either pyrethroid or organophosphorus insecticides, including mixtures of organophosphates such as diazinon (i.e, a pyrimidine organothiophosphate) and chlorpyrifos (i.e., a pyridine organothiophosphate), releasably impregnated into a resin base. The insecticide mixture is slowly released from the resin base onto the hair of the animal and exhibits good contact toxicity results with respect to various pests, including hornflies, stable flies, and house flies. A complete discussion of this technology can be found in commonly-assigned U.S. Patent No. 5,472,955, the entire disclosure being incorporated herein by reference. An ear tag containing a

mixture of diazinon and chlorpyrifos is readily commercially available from Y-Tex Corporation (Cody, Wyoming) and is being marketed under the trademark WARRIOR™.

Recently, another ear tag has been developed by Y-Tex Corporation and is being marketed under the trademark PYTHON™. This ear tag is similar to the WARRIOR™ ear tag in that a synergized insecticide is impregnated into a resin base. However, the PYTHON™ ear tag differs primarily from the WARRIOR™ ear tag in that the impregnated insecticide is an enriched-isomer, synthetic pyrethroid compound, as opposed to an organothiophosphate compound. A synthetic pyrethroid compound is generally defined as a synthetic pesticide that mimics pyrethrin, the original botanical pesticide derived from certain species of chrysanthemum flowers. Examples of pyrethroid compounds include, without limitation, allethrins, resmethrins, permethrins, and fenvalerates. The synthetic pyrethroids have the marked advantages of low to moderate toxicity to humans and domestic animals and high effectiveness at low application rates, often one-tenth of those required for organophosphorus and carbamate insecticides. The PYTHON™ ear tag utilizes zeta-cypermethrin (empirical formula: $C_{22}H_{19}Cl_2NO_3$) as the insecticide. Zeta-cypermethrin (readily commercially available from FMC Corporation, Philadelphia, Pennsylvania) is a mixture of stereoisomers comprising high concentrations of s-isomers of cypermethrin. The zeta-cypermethrin is then combined with a synergist, such as piperonyl butoxide (empirical formula: $C_{19}H_{30}O_5$), to produce a synergized insecticide. The PYTHON™ ear tag exhibits excellent contact toxicity against horn flies (including horn flies with moderate pyrethroid resistance), face flies (*Musca autumnalis*), lice (*Phthiraraptera* order), Gulf Coast ticks (*Ambylomma maculatum*), and spinose ear ticks (*Otobius megnini*).

Although the development of releasable insecticide impregnated ear tags has aided tremendously in

the control and prevention of insect infestation of livestock, the protection of other domestic animals, such as dogs and cats (also referred to as companion animals), has lagged behind. Of particular interest is the treatment and prevention of flea and tick infestations in dogs and cats.

Fleas are very important pests, especially during the summer months when heat and humidity levels are high. Adult fleas are not only a nuisance, but can cause medical problems including flea allergy dermatitis, tapeworms, secondary skin irritations, and anemia. It is estimated that pet owners spend over one billion dollars each year controlling fleas, especially the cat flea (*Ctenocephalides felis*) and the dog flea (*Ctenocephalides canis*).

Fleas pass through a complete life cycle consisting of egg, larvae, pupa, and adult. A typical flea population consists of 50 percent eggs, 35 percent larvae, 10 percent pupae, and 5 percent adults. Completion of the life cycle from egg to adult varies from two weeks to eight months depending on the temperature, humidity, food, and species. Normally after a blood meal, the female flea lays about 15 to 20 eggs per day and up to 600 in a lifetime, usually on the host (e.g., dogs, cats, rats, rabbits, mice, squirrels, chipmunks, raccoons, opossums, foxes, chickens, humans, etc.). Eggs loosely laid in the hair coat, drop out most anywhere especially where the hosts rests, sleeps, or nests (e.g., rugs, carpets, upholstered furniture, cat or dog boxes, kennels, sand boxes, etc.). Eggs hatch in two days to two weeks into larvae found indoors in floor cracks and crevices, along baseboards, under rug edges, and in furniture and beds. Outdoor development occurs in sandy gravel soils (e.g., moist sand boxes, dirt crawlspace under the house, under shrubs, etc.) where the pet may rest or sleep.

Ticks are blood feeding external parasites of mammals, birds, and reptiles throughout the world. Approximately 850 species have been described worldwide.

Ticks transmit the widest variety of pathogens of any blood sucking arthropod, including bacteria, rickettsiae, protozoa, and viruses. Some animal diseases of current interest in the United States caused by tick-borne pathogens include Babesiosis, Ehrlichiosis, Haemobartonellosis, Rocky Mountain spotted fever, Lyme disease, Hepatozoonosis, and Cytauxzoonosis. There are two well established families of ticks, the Ixodidae (hard ticks) and the Argasidae (soft ticks). Both are important vectors of disease causing agents to humans and animals throughout the world.

Hard ticks have three distinct life stages. Larvae which emerge from the egg have six legs. After obtaining a blood meal from a vertebrate host, they molt to the nymphal stage and acquire eight legs. Nymphs feed and molt to the next and final stage - the adult, which also has eight legs. After feeding once more, the adult female hard ticks lay one batch of thousands of eggs and then die. Only one blood meal is taken during each of the three life stages. The time to completion of the entire life cycle may vary from less than a year in tropical regions to over three years in cold climates, where certain stages may enter diapause until hosts are again available. Many hard ticks can go for several months without feeding if not unduly stressed by environmental conditions. An example of the hard tick is the American Dog Tick (*Dermacentor variabilis*).

The life stages of soft ticks are not readily distinguishable. The first life stage to come out of the egg, a six-legged larva, takes a blood meal from a host, and molts to the first nymphal stage. Unlike hard ticks, many soft ticks go through multiple nymphal stages, gradually increasing in size until the final molt to the adult stage. Some soft ticks pass through up to seven nymphal molts before they become adults. Soft ticks feed several times during each life stage, and females lay multiple small batches of eggs between blood meals during

their lives. The time to completion of the entire life cycle is generally much longer than that of hard ticks, lasting over several years. Additionally, many soft ticks have an uncanny resistance to starvation, and can survive for over two years without a blood meal. An example of such is the Spinose Ear Tick (*Otobius megnini*).

The treatment and prevention of flea and tick infestation in dogs and cats has typically been accomplished through various methods, including: (1) neck collars having a releasable impregnated insecticide composition; (2) the use of topically applied insecticide-containing compositions in the form of "spot-ons", shampoos, aerosols, dips, sprays, and powders; and (3) orally administered insecticide compositions which are systemically active, such as a pill for flea control.

Neck collars having a releasable impregnated insecticide composition are well known. Generally, the neck collar, also commonly referred to as a flea collar, is comprised of some type of plasticized thermoplastic polymer that is extruded, coextruded or injection molded, or compounded with an insecticide, typically an organophosphate or carbamate compound. These compounds usually have objectionable odors, and the insecticide employed is typically effective against the parasitic life stages of fleas and/or ticks. Another active ingredient used in collars is an insect growth regulator (IGR) which is active against the eggs and larval fleas.

The neck collar is placed around the neck of the animal and adjusted to fit snugly about the animal's neck; thus, it is not considered to be free-swinging. The neck collar typically was employed in addition to the animal's pre-existing collar that may have contained identification tags, vaccinations tags, and the like. The insecticide then diffuses out of the collar in the form of either a viscous liquid or a powder, depending on the melting point of the particular insecticide. The insecticidal residues are then transferred to the animal's hair. The efficacy of

the insecticide released from neck collars has been always been problematic. There are two primary reasons for this difficulty: (1) limited mobility of the collar which limits application of insecticide residues; and (2) low release rate because of the requirement to make the collar durable.

Furthermore, the durability of typical insecticide collars is still inadequate to permit the attachment of a leash, and thus the owner must still maintain a typical collar of leather, nylon, or other suitably strong material for the purposes of attaching a leash and identifying tags.

One example of a topically applied insecticide composition is marketed under the trademark ADVANTAGE™ by Bayer (Leverkusen, Germany). ADVANTAGE™ is comprised of a solution of imidacloprid (chemical formula: 1-[(6-Chloro-3-pyridinyl) methyl]-N-nitro-2-imidazolidinimine), a chloronicotinyl nitroguanidine synthesized from the nitromethylene class of compounds. Imidacloprid is supposedly selectively active against adult fleas and flea larvae; however, it has no effect against flea eggs, nor does it have any acaricidal properties. Imidacloprid binds to the nicotinyl receptor site in the post-synaptic region of the adult flea's nerve, thus interfering with normal nerve transmissions and causing eventual death. The imidacloprid solution is topically applied (i.e., spot-on) once a month between the shoulder blades of the animal and is spread to the other parts of the animal by a process known as translocation.

Another example of a topically applied insecticide composition is marketed under the trademark FRONTLINE™ by Merial (Lyon, France). FRONTLINE™ is comprised of a solution of fipronil (chemical formula: 5-amino-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-[(1R,S)-(trifluoromethyl)sulfinyl]-1H-pyrazole-3-carbonitrile). Fipronil is supposedly selectively active against adult fleas and ticks; however, it has no effect against the other life stages of fleas or ticks. Fipronil acts on the

gamma aminobutyric acid (GABA) mediated chloride channels of invertebrates. Fipronil blocks the passage of chloride ions in the adult flea or tick thus blocking nerve transmission and causing eventual death. Again, like imidacloprid, the fipronil solution is topically applied (i.e., spot-on) between the shoulder blades of the animal and is spread to the other parts of the animal by translocation. Although a single application of fipronil is supposedly effective against fleas for up to about 3 months, it is only effective against ticks for up to 1 month. Therefore, monthly applications would appear to be necessary.

Still another example of a topically applied insecticide composition is marketed under the trademark DEFEND™ by Schering-Plough (Madison, New Jersey). DEFEND™ is comprised of a high concentrate solution (about 60 vol. %) of permethrin (chemical formula: 3-phenoxybenzyl). Permethrin is active against fleas, ticks, flies, and mosquitoes. The permethrin solution is applied (i.e., spot-on) between the shoulder blades of the animal, typically a dog, and is spread to the other parts of the animal by translocation. However, permethrin is relatively toxic to cats, and therefore is not recommended to be applied in a topical solution to cats. Monthly applications to dogs are required throughout the flea and tick seasons.

An example of an orally administered insecticide composition is marketed under the trademark PROGRAM™ by Ciba-Geigy (Greensboro, North Carolina). PROGRAM™ is comprised of lufenuron (chemical formula: N-[2,5-dichloro-4-(1,1,2,3,3,3,-hexafluoropropoxy)-phenylaminocarbonyl]-2,6-difluorobenzamide), a benzoylphenyl-urea derivative. Lufenuron is supposedly selectively active against flea eggs; however, it has no effect on the other life stages of fleas, nor does it have any acaricidal properties. Lufenuron interferes with chitin synthesis, polymerization, and deposition in the flea egg. Eliminating the

availability of chitin prevents the flea from completing its development. Additionally, if development did occur, the emerging flea would quickly desiccate due to the lack of chitin in the body shell. Lufenuron is orally administered in tablet form on a monthly basis, with a suggested treatment period of six months.

Although these products have, to a certain extent, aided in the control of flea and tick infestation of dogs and cats, they have several disadvantages. Traditional insecticidal collars are limited in their efficacy, typically have objectionable odors, and require the use of an additional collar in addition to the animal's pre-existing collar. This is an inconvenience and can cause skin irritation to the animal. The topically applied insecticide-containing compositions are generally oily and slightly toxic to humans as well as animals, thus requiring the need for a high degree of care when applying to the animal. Even after application is complete, these topically applied insecticide-containing compositions may take more than a day to completely dry. Orally administered insecticide compositions are sometimes very difficult to administer to an uncooperative animal, especially cats, and may not be well tolerated by the animal's digestive system. Further, the pest still has to bite the animal in order to receive a toxic dose.

However, the greatest disadvantage of all three of these product groups is that none of them are capable of preventing and treating flea and tick infestation of a domestic animal over long periods of time, without the need for an additional collar or monthly re-applications of insecticide, wherein the insecticide composition is effective against all the parasitic life stages of fleas and ticks. By "parasitic life stage" as that term is used herein, it is meant any life stage wherein the flea or tick is capable of taking a blood meal from a host.

Therefore, there exists a need for a safe, ready-to-use insecticide composition and method of use thereof

for the long-term prevention and treatment of tick and flea infestation in domestic animals, especially dogs and cats, wherein the insecticide composition can be easily attached to existing neck collars and which is effective against all the parasitic life stages of ticks and fleas.

SUMMARY OF THE INVENTION

In accordance with one embodiment of the present invention, a free-swinging, slow-release insecticidal tag is designed for attachment to the neck collar of a domesticated animal for the prevention and treatment of tick and flea infestation. The insecticide includes at least one pyrethroid compound, such as, but not limited to zeta-cypermethrin. A synergist, such as, but not limited to piperonyl butoxide is combined with the zeta-cypermethrin to produce a synergized insecticide. The synergized insecticide is then impregnated into a resin base, such as, but not limited to polyvinyl chloride, acrylonitrile-butadiene copolymer, polyurethane, and chlorinated polyethylene, and then formed into the shape of a tag or medallion. The tag is then attached to the neck collar of the animal in such a manner so as to allow the tag to physically contact various parts of the animal's body, for example, during the grooming process. The synergized insecticide is released from the tag over the course of several months and is particularly effective against all of the parasitic life stages of various domestic animal pests, such as, but not limited to ticks and fleas.

A more complete appreciation of the present invention and its scope can be obtained from understanding the accompanying drawings, which are briefly summarized below, the following detailed description of the invention, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an insecticidal

tag, in accordance with the general teachings of the present invention;

Figure 2 is a side elevational view of an attachment means for use with the insecticidal tag depicted in Figure 1;

Figure 3 is a perspective view of a collar incorporating the insecticidal tag depicted in Figure 1 and the attachment means depicted in Figure 2; and

Figure 4 is a perspective view of an intended use of the insecticidal tag depicted in Figure 1.

The same reference numerals refer to the same parts throughout the various Figures.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is primarily directed to the use of a free-swinging, slow release insecticidal neck tag or medallion for the prevention and treatment of flea and tick infestation of domestic animals, such as, but not limited to dogs and cats. By "free-swinging" as that term is used herein, it is meant that the tag is allowed substantially unfettered freedom of movement in all directions. By the term "slow release" as that term is used herein, it is meant that the insecticide is released from the tag over a period of several months. By the term "neck tag or medallion" as that term is used herein, it is meant any shaped object that is capable of being attached, either directly or indirectly, to the neck collar of a domestic animal.

The insecticide composition of the present invention preferably includes at least one releasable oil-soluble contact-effective insecticide. Preferably the releasable oil-soluble contact-effective insecticide is at least one pyrethroid compound, such as, but not limited to zeta-cypermethrin (preferably a mixture of stereoisomers comprising high concentrations of s-isomers of cypermethrin) in combination with at least one synergist such as, but not limited to piperonyl butoxide (preferably

technical grade). The insecticide composition of the present invention preferably contains up to about 10 weight percent zeta-cypermethrin and up to about 20 weight percent piperonyl butoxide, which could be varied by several percentage points without substantially affecting efficacy. These weight percents are based on the total weight of the tag. Preferably, the ratio of zeta-cypermethrin to piperonyl butoxide is about 1:2 by weight.

Additionally, other pyrethroid compounds that have demonstrated insecticidal and/or acaricidal activity may also be used, including but not limited to deltamethrin, alphacypermethrin, permethrin, bifenthrin, flumethrin, cyfluthrin, beta-cyfluthrin, fenvalerate, esfenvalerate, cyhalothrin, lambdacyhalothrin, tralomethrin, fenpropathrin, fenfluthrin, fluvalinate, tetramethrin, tefluthrin, flucythrinate, and etofenprox.

The insecticide composition of the present invention is preferably releasably impregnated into a resin base. The impregnation can be accomplished by any number of suitable means, such as, but not limited to co-extrusion, compounding, or blending. Preferably, the resin base is capable of allowing the insecticide composition to be slowly released from the resin base over an extended period of time, such as several months. Preferably, the impregnated resin base is substantially odorless.

The impregnated resin base is then formed by suitable means, such as injection molding or profile extrusion and stamping processes, into a desired shape such as, but not limited to a tag or medallion **10** as depicted in Figure 1. The exact shape and dimensions of the tag **10** are not thought to be critical to the success of the present invention. Rather, it is the free-swinging characteristic that is thought to be critical. It should be noted that the size of the tag **10** will be dependent in part on the size of the animal that is to be treated. For example, a 5 pound cat may require a smaller and lighter tag than a 150 pound dog. In accordance with a preferred embodiment

of the present invention, the tag **10** weighs about 2.5 to about 7 grams, to allow for different sizes of tags to be manufactured for different sizes of animals. Additionally, the tag **10** may be provided with an area defining an aperture **12** for mounting a fastener to be used for attachment to the animal's pre-existing collar.

Once the tag **10** has been formed, it may be easily mounted by hand to the animal's pre-existing neck collar. Thus, there is no need for an additional collar, as is required with conventional flea collars. Although the tag **10** of the present invention may be formed to include an integrated attachment means, such as a hook-shaped appendage, for direct mounting to the animal's neck collar, it may be preferable to use a separate attachment means. With reference to Figure 2, a separate attachment means **20** formed of a substantially durable material (e.g., metal or hard plastic) may used to attach the tag **10** to the neck collar, thus allowing the tag **10** to hang freely down about the animal's chest area. The attachment means **20** may be placed or folded over the neck collar and then employ a snap assembly **22** that fits through the aperture **12** provided on the upper part of the tag **10**. In this manner, the tag **10** is securely, but not rigidly, affixed to the attachment means **20** and the attachment means **20** is securely, but not rigidly, affixed to the neck collar **30** as depicted in Figure 3.

Without being bound to a particular theory of the operation of the present invention, it is believed that this insecticide composition, when impregnated into a free-swinging, resin-based tag, is effective against both fleas and ticks, especially the Brown Dog tick (*Rhipicephalus sanguineus*), the American Dog tick (*Dermacentor variabilis*), the Lone Star tick (*Amblyomma americanum*), and the Deer tick (*Ixodes scapularis*).

The resin base employed may be thermosetting or thermoplastic, although the latter is more readily employed in the manufacture of a tag of the present invention.

Examples of suitable substances are polyolefins (e.g., polyethylene, polypropylene and copolymers of ethylene and propylene); halogenated polyolefins (e.g., chlorinated polyethylene); polyacrylates (e.g., polymers and copolymers of methyl acrylate, ethyl acrylate, methyl methacrylate and ethyl methacrylate); polymers of vinyl compounds (e.g., polystyrene and polymerized divinylbenzene); polyvinyl halides (e.g., polyvinyl chloride); polyvinyl acetals (e.g., polyvinyl butyryl); polyvinylidene compounds (e.g., polyvinylidene chloride); synthetic and natural elastomers (e.g., rubber obtained from hevea brasiliensis, cis-1,4-polyisoprene, acrylonitrile-butadiene copolymers (NBR), polybutadiene styrene-butadiene copolymer (SBR); urea-formaldehyde and melamine-formaldehyde resins; epoxy resins (e.g., polymers of polyglycidyl ethers of polyhydric phenols); cellulose plastic (e.g., cellulose acetate, cellulose butyrate and cellulose nitrate); and polyurethanes. It should be noted that the choice of the resin base will depend both on the particular insecticide mixture with which it is to be formulated and the conditions under which the final formulation will be employed. To be most effective, the resin base is preferably insoluble in water and presents a hydrophobic surface, thus resisting the absorption of moisture on its surface which could dilute the active ingredients.

Preferably, the resin base may include a polymer or a copolymer of a vinyl compound, for example, polyvinyl halides (e.g., polyvinyl chloride and polyvinyl fluoride); polyacrylate and polymethacrylate esters (e.g., polymethyl acrylate, polymethyl acrylate and polymethyl methacrylate); and polymers of vinyl benzenes (e.g., polystyrene and polymer polymerized vinyl toluene). Because it possesses desirable physical properties with desirable release rate characteristics for the insecticide, one of the preferred macromolecular substances is a polymer of vinyl chloride.

It is generally necessary to include a plasticizer in the resin base in order to enable

satisfactory tags to be formed from it. Examples of plasticizers are phthalates (e.g., di(2-ethylhexyl) phthalate, diethylglycol phthalate, dioctyl phthalate, diphenyl phthalate, dicyclohexyl phthalate, dimethyl phthalate, diethyl phthalate, dihexyl phthalate, di(2-ethylhexyl) isophthalate, and di(2-ethylhexyl) hexahydrophthalate); sebacates (e.g., di(2-ethylhexyl) sebacate, dipentyl sebacate, n-butyl benzyl sebacate, dimethyl sebacate, and dibenzyl sebacate); adipates (e.g., isobutyl adipate, di(2-ethylhexyl) adipate, dicapryl adipate, dioctyl adipate and dinonyl adipate); citrates (e.g., acetyltributyl citrate and acetyl triethyl citrate); succinates; azelates; stearates; and trimellitates. Other compatible plasticizers are, for example, hydrogenated polyphenols; alkylated aromatic hydrocarbons; polyester plasticizers, for example, polyesters of polyols, such as hexanediol; polycarboxylic acids, such as sebacic or adipic acid, having molecular weights of about 2000; and epoxide plasticizers such as epoxidized soybean oil, epoxidized linseed oil and epoxidized tall oils (such as octyl epoxy tallate). Without being bound to a particular theory of the operation of the present invention, it is believed that a relatively softer resin base, as opposed to a relatively harder resin base, will enhance the delivery of the insecticide composition when the tag **10** contacts the animal's body. It is believed that higher concentrations of plasticizers, which cause a softer resin base, enable higher release rates of impregnated insecticides.

Other materials such as dyes, pigments, colorants, fluorescents, lubricants, fillers, anti-oxidants and ultraviolet stabilizers may be included in the formulation. For example, it has been found that the stability of the formulation is extended if amounts of 0.10% to about 0.25% by weight, of each one or more suitable chemical stabilizers are included. For example, certain hydroxycinnamates (such as IRGANOX® 1076, octadecyl 3,5 -di-tert-butyl-4-hydroxyhydrocinnamate) and

benzotriazoles (such as TINUVIN® P, 2 -(2'-hydroxy-5'-methylphenyl)benzotriazole) are effective as stabilizers against heat and ultraviolet light degradation.

With reference to Figure 4, there is illustrated an intended use of the tag **10** of the present invention. In this case, a cat is wearing a collar **30** having the tag **10** of the present invention attached thereto by an attachment means **20** (as previously depicted in Figure 3). As the cat grooms itself, the tag **10** is brushed up against various parts of the cat's body, thus releasing the insecticide composition onto those parts of the cat's body. In this manner, the entire body of the cat is exposed to the insecticide composition.

Test data has indicated that the free-swinging, insecticidal tag **10** of the present invention is effective against the parasitic life stages of ticks for about 2 to 3 months. Additionally, test data indicated that the free-swinging, insecticidal tag **10** of the present invention is effective against the parasitic life stages of fleas for over 5 months.

By way of a non-limiting example, an experiment was conducted to determine the efficacy of the insecticidal tag **10** of the present invention against flea infestation. Two groups of three mixed-breed dogs, an untreated control group and a treated group wearing a 7 gram insecticidal tag (Ref. No. YT-1601-M1) produced in accordance with the general teachings of the present invention (e.g., a mixture comprising up to about 10 weight percent zeta-cypermethrin and up to about 20 weight percent piperonyl butoxide), were exposed to cat fleas, *Ctenocephalides felis*, over a 153 day period. The results of the experiment are presented in Table I, below:

Table I

Day	Total # of Fleas on All Dogs of Control Group	Total # of Fleas on All Dogs of Treated Group	% Flea Control on Treated Group
1*	171	34	80.1
3	139	5	96.4
7*	204	34	83.3
9	248	18	92.7
14*	197	3	98.5
16	219	5	97.7
21*	289	1	99.7
23	272	1	99.6
28*	236	1	99.6
30	195	1	99.5
36*	173	0	100
38	223	0	100
42*	272	2	99.3
44	252	0	100
49*	249	1	99.6
51	236	0	100
77*	213	1	99.5
79	202	0	100
107	206	4	98.1
135	176	5	97.2
153	191	6	96.9

The asterisk denotes that, on the day proceeding the day indicated, each of the dogs were challenged with 100 fleas. Visual counts were made on the day denoted with

an asterisk. The fleas were then combed off and counted two days later, i.e., those days not denoted with an asterisk. Thus, all days without an asterisk are three days post-challenge.

As Table I indicates, the insecticidal tag **10** of the present invention was highly efficacious in the prevention and treatment of flea infestation in the treated group of dogs.

By way of a non-limiting example, an experiment was conducted to determine the efficacy of the insecticidal tag **10** of the present invention against tick infestation. Three groups of four beagle dogs, an untreated control group and two treated group, one wearing a 4 gram (Ref. No. YT-1601-M3), and the other a 2.5 gram (Ref. No. YT-1601-M4), insecticidal tag produced in accordance with the general teachings of the present invention (e.g., a mixture comprising up to about 10 weight percent zeta-cypermethrin and up to about 20 weight percent piperonyl butoxide), were exposed to brown dog ticks, *Rhipicephalus sanguineus*, over a 79 day period. The results of the experiment are presented in Table II, below:

Table II

Day	Total # of Ticks on All Dogs of Control Group	Total # of Ticks on All Dogs of Treated Group (4 gram tag)	% Tick Control on 4 gram tag Treated Group	Total # of Ticks on All Dogs of Treated Group (2.5 gram tag)	% Tick Control on 2.5 gram tag Treated Group
7*	58	1	98.38	6	90
9	66	0	100	4	93.9
14*	60	2	96.7	3	95
16	60	1	98.3	1	98.3
21*	90	4	95.6	3	96.7
23	90	2	97.8	1	98.9
37	82	1	98.8	3	96.3
58	72	22	69.4	44	38.9
79	97	46	52.6	41	57.7

The asterisk denotes that, on the day proceeding the day indicated, each of the dogs were challenged with 50 ticks. Visual counts were made on the day denoted with an asterisk. The ticks were then counted and removed two days later, i.e., those days not denoted with an asterisk. Thus, all days without an asterisk are three days post-challenge.

As Table II indicates, the insecticidal tag **10** of the present invention was highly efficacious in the prevention and treatment of tick infestation in the treated groups of dogs.

By way of a non-limiting example, another experiment was conducted to determine the efficacy of the insecticidal tag **10** of the present invention against tick infestation. Thirteen Walker hound dogs, of which three are control subjects (denoted C1, C2, and C3), with the remaining ten dogs wearing a 7 gram insecticidal tag (Ref.

No. YT-1601-M1) produced in accordance with the general teachings of the present invention (e.g., a mixture comprising up to about 10 weight percent zeta-cypermethrin and up to about 20 weight percent piperonyl butoxide), were exposed to naturally occurring tick infestation, e.g., in an outdoor kennel setting, over a 42 day period. The results of the experiment are presented in Table III, below:

Table III

Dog #	Day 0 Tick Count	Day 7 Tick Count	Day 14 Tick Count	Day 21 Tick Count	Day 28 Tick Count	Day 35 Tick Count	Day 42 Tick Count
1	H	L	L	L	L	L	L
2	VH	L	L	L	L	L	M
3	VH	L	L	L	L	M	M
4	H	L	L	L	M	M	M
5	VH	L	L	L	M	M	M
6	VH	L	L	L	L	L	M
7	H	L	L	L	M	M	M
8	VH	L	L	L	L	L	M
9	VH	L	L	L	L	L	L
10	H	L	L	L	L	L	L
C1	VH	VH	VH	VH	VH	VH	VH
C2	VH	VH	VH	VH	VH	VH	VH
C3	VH	VH	NA	NA	NA	NA	NA

On Day 0, the insecticidal tags of the present invention were applied to the collars of the non-control dogs. The dogs were then examined to estimate the number of ticks present, with a light infestation (i.e., less than 10 ticks) denoted as L, a moderate infestation (i.e., 10 to 50 ticks) denoted as M, a heavy infestation (i.e., 50 to 100 ticks) denoted as H, and a very heavy infestation (i.e., greater than 100 ticks) denoted as VH. The term NA (i.e., not available) refers to the fact that control dog number 3 (C3) had to be removed from the experimental study due to anemia and weakness. Thus, tick counts for Days 14, 21, 28, 35, and 42 could not be taken for this particular dog.

As Table III indicates, the insecticidal tag **10** of the present invention was highly efficacious in the prevention and treatment of tick infestation in the treated groups of dogs.

By way of a non-limiting example, an experiment was conducted to determine the efficacy of the insecticidal tag **10** of the present invention against both flea and tick infestation. A treated group of dogs wearing a 7 gram insecticidal tag (Ref. No. YT-1601-M1) produced in accordance with the general teachings of the present invention (e.g., a mixture comprising up to about 10 weight percent zeta-cypermethrin and up to about 20 weight percent piperonyl butoxide), were exposed to fleas and ticks over an 85 day period. At periodic intervals, the dogs were infested with fleas for one day and ticks for two days prior to evaluation, at which time all of the pests were removed from each dog, whereupon, the efficacy of the tag against flea and tick infestation was determined. The results of the experiment are presented in Table IV, below:

Table IV

Day of Removal of Pests	Day Infested by Fleas	% Flea Efficacy	Day Infested by Ticks	% Tick Efficacy
15	14	100	13	100
29	28	100	27	95.9
43	42	99.6	41	92.2
57	56	100	55	100
71	70	96.7	69	100
85	84	96.7	83	100

As Table IV indicates, the insecticidal tag **10** of the present invention was highly efficacious in the prevention and treatment of both flea and tick infestation in the treated groups of dogs.

The foregoing description is considered illustrative only of the principles of the invention. Furthermore, because numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and process shown as described above. Accordingly, all suitable modifications and equivalents that may be resorted to that fall within the scope of the invention as defined by the claims that follow.

What is claimed is:

1. A free-swinging, insecticidal neck tag for the prevention and treatment of flea and tick infestation of domestic animals, comprising:

a) an effective amount of one or more releasable oil-soluble contact-effective insecticides; and

b) a resin base, wherein the insecticide is releasably impregnated into the resin base.

2. The invention according to claim 1, wherein the insecticide is effective against all parasitic life stages of fleas and ticks.

3. The invention according to claim 1, wherein the insecticide comprises at least one pyrethroid compound.

4. The invention according to claim 3, wherein the pyrethroid compound comprises zeta-cypermethrin.

5. The invention according to claim 1, further comprising at least one synergist.

6. The invention according to claim 5, wherein the synergist comprises piperonyl butoxide.

7. The invention according to claim 4, further comprising at least one synergist.

8. The invention according to claim 7, wherein the synergist comprises piperonyl butoxide.

9. The invention according to claim 8, wherein the ratio of zeta-cypermethrin to piperonyl butoxide is about 1:2 by weight.

10. The invention according to claim 8, wherein the zeta-

cypermethrin is present in an amount up to about 10 weight percent based on the total weight of the tag.

11. The invention according to claim 8, wherein the piperonyl butoxide is present in an amount up to about 20 weight percent based on the total weight of the tag.

12. The invention according to claim 1, wherein the resin base comprises compounds selected from the group consisting of polyvinyl chloride, acrylonitrile-butadiene copolymer, polyurethane, chlorinated polyethylene, and mixtures thereof.

13. The invention according to claim 1, wherein the resin base further comprises compounds selected from the group consisting of plasticizers, stabilizers, colorants, fluorescents, and mixtures thereof.

14. The invention according to claim 1, further comprising:

a) a collar; and

b) an attachment means for connecting the neck tag to the collar.

15. The invention according to claim 1, wherein the tick is selected from the group consisting of Brown Dog ticks, *Rhipicephalus sanguineus*, American Dog ticks, *Dermacentor variabilis*, Lone Star ticks, *Amblyomma americanum*, Deer ticks, *Ixodes scapularis*, and combinations thereof.

16. An insecticidal composition for the prevention and treatment of tick and flea infestation in domestic animals, comprising:

a) an effective amount of one or more releasable oil-soluble contact-effective insecticides; and

b) a resin base, wherein the insecticide is releasably impregnated into the resin base, the insecticide

being topically applied to the domestic animal when the impregnated resin base physically contacts the domestic animal.

17. The invention according to claim 16, further comprising at least one synergist.

18. The invention according to claim 17, wherein the synergist comprises piperonyl butoxide.

19. The invention according to claim 16, wherein the insecticide is effective against all parasitic life stages of fleas and ticks.

20. The invention according to claim 16, wherein the insecticide comprises at least one pyrethroid compound.

21. The invention according to claim 20, wherein the pyrethroid compound comprises zeta-cypermethrin.

22. The invention according to claim 18, wherein the insecticide comprises at least one pyrethroid compound.

23. The invention according to claim 22, wherein the pyrethroid compound comprises zeta-cypermethrin.

24. The invention according to claim 23, wherein the ratio of zeta-cypermethrin to piperonyl butoxide is about 1:2 by weight.

25. The invention according to claim 23, wherein the zeta-cypermethrin is present in an amount up to about 10 weight percent based on the total weight of the tag.

26. The invention according to claim 23, wherein the piperonyl butoxide is present in an amount up to about 20 weight percent based on the total weight of the tag.

27. The invention according to claim 16, wherein the resin base comprises compounds selected from the group consisting of polyvinyl chloride, acrylonitrile-butadiene copolymer, polyurethane, chlorinated polyethylene, and mixtures thereof.

28. The invention according to claim 16, wherein the resin base further comprises compounds selected from the group consisting of plasticizers, stabilizers, colorants, fluorescents, and mixtures thereof.

29. The invention according to claim 16, wherein the tick is selected from the group consisting of Brown Dog ticks, *Rhipicephalus sanguineus*, American Dog ticks, *Dermacentor variabilis*, Lone Star ticks, *Amblyomma americanum*, Deer ticks, *Ixodes scapularis*, and combinations thereof.

30. A method for the prevention and treatment of flea and tick infestation of domestic animals, comprising the steps of:

a) providing an effective amount of one or more releasable oil-soluble contact effective insecticides;

b) providing a resin base wherein the insecticide is releasably impregnated into the resin base; and

c) forming the impregnated resin base into a tag, wherein the tag is allowed to freely swing from the neck of the domesticated animal.

31. The invention according to claim 30, further comprising the step of providing at least one synergist.

32. The invention according to claim 31, wherein the synergist comprises piperonyl butoxide.

33. The invention according to claim 30, wherein the insecticide is effective against all parasitic life stages of fleas and ticks.

34. The invention according to claim 30, wherein the insecticide comprises at least one pyrethroid compound.

35. The invention according to claim 34, wherein the pyrethroid compound comprises zeta-cypermethrin.

36. The invention according to claim 32, wherein the insecticide comprises at least one pyrethroid compound.

37. The invention according to claim 36, wherein the pyrethroid compound comprises zeta-cypermethrin.

38. The invention according to claim 37, wherein the ratio of zeta-cypermethrin to piperonyl butoxide is about 1:2 by weight.

39. The invention according to claim 37, wherein the zeta-cypermethrin is present in an amount up to about 10 weight percent based on the total weight of the tag.

40. The invention according to claim 37, wherein the piperonyl butoxide is present in an amount up to about 20 weight percent based on the total weight of the tag.

41. The invention according to claim 30, wherein the resin base comprises compounds selected from the group consisting of polyvinyl chloride, acrylonitrile-butadiene copolymer, polyurethane, chlorinated polyethylene, and mixtures thereof.

42. The invention according to claim 30, wherein the resin base further comprises compounds selected from the group consisting of plasticizers, stabilizers, colorants, fluorescents, and mixtures thereof.

43. The invention according to claim 30, further comprising the steps of:

a) providing a collar; and

b) providing an attachment means for connecting the neck tag to the collar.

44. The invention according to claim 30, wherein the tick is selected from the group consisting of Brown Dog ticks, *Rhipicephalus sanguineus*, American Dog ticks, *Dermacentor variabilis*, Lone Star ticks, *Amblyomma americanum*, Deer ticks, *Ixodes scapularis*, and combinations thereof.

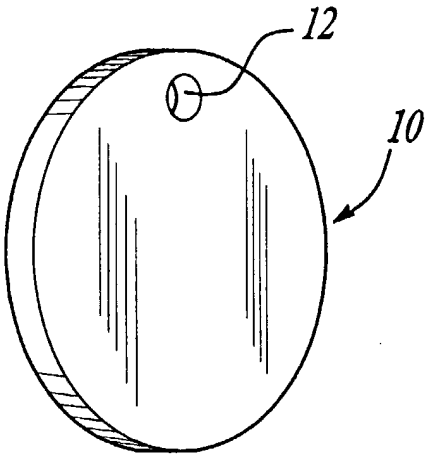

Fig-1

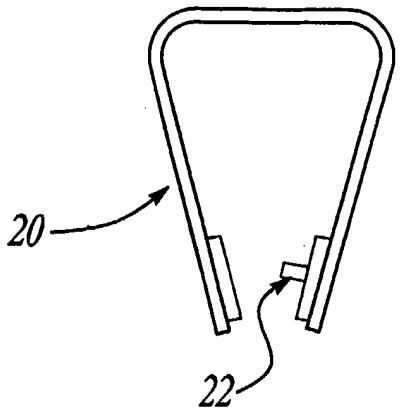

Fig-2

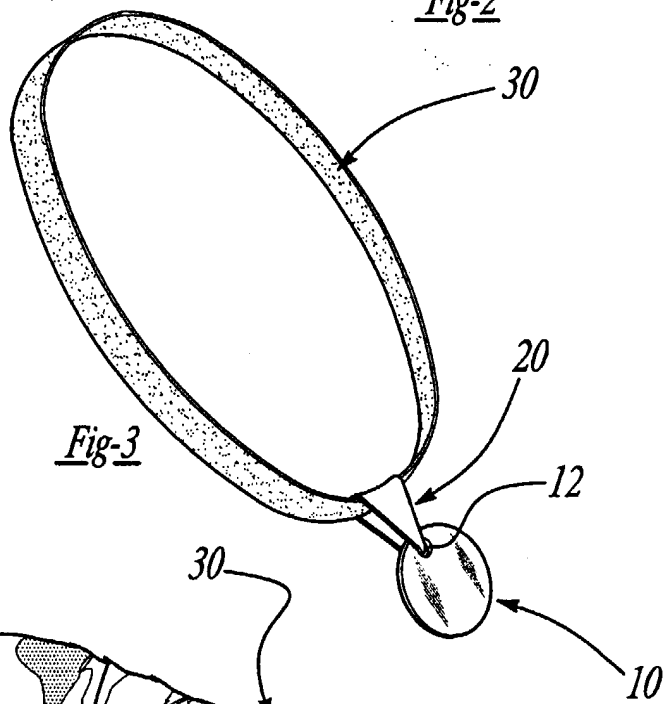

Fig-3

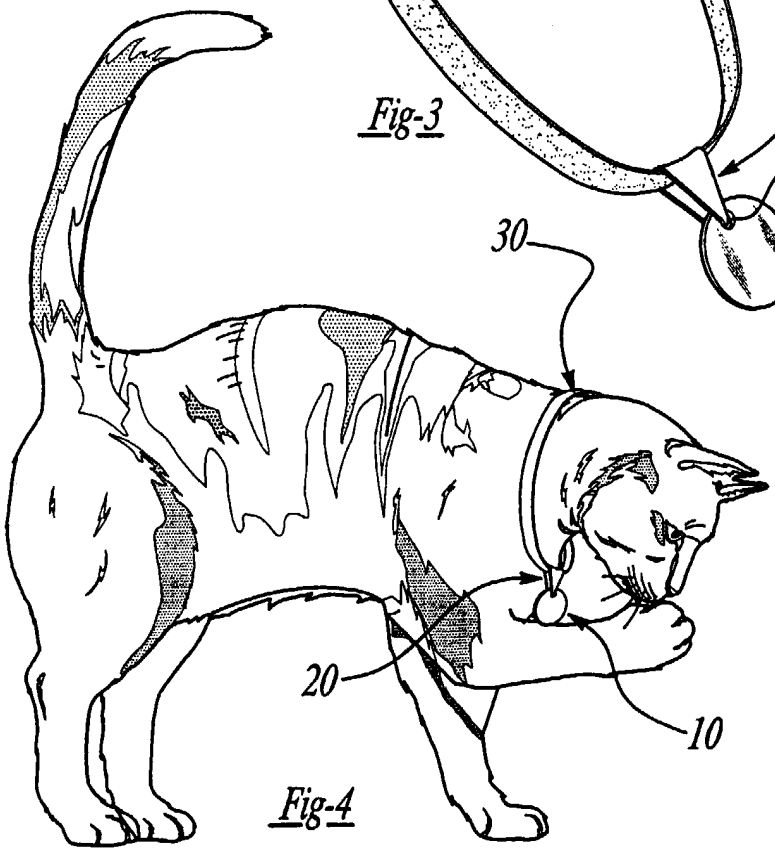

Fig-4